AMD Embedded G-Series SOC (Family 16h Models 00h-0Fh) Product Data Sheet

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Revision History

Date	Revision	Description
February 2014	3.04	Fifth Public Release
November 2013	3.03	Fourth Public Release. Updated Integrated Controller Hub.
October 2013	3.02	Third Public Release. Updated Table 2 on page 12.
June 2013	3.00	First Public Release

1 AMD Embedded G-Series SOC (Family 16h Models 00h-0Fh) Features

1.1 Processor Features

This section lists the features of the processor

- **Compatible with Existing 32-Bit x86 and 64-bit AMD64 Code Base**
  - Including support for SSE, SSE2, SSE3, SSE4a, SSE4.1, SSE4.2, SSSE3, ABM, AVX, AES, BMI, XSAVE/XRSTOR, XGETBV/XSETBV, PCLMULQDQ, MOVBE, POPCNT, F16C, MMX™, and legacy x86 instructions
  - Runs existing operating systems and drivers
  - Local APIC on the chip
  - Light Weight Profiling (LWP) support
- **AMD64 Technology**
  - AMD64 technology instruction-set extensions
  - 64-bit integer registers, 48-bit virtual addresses, and 40-bit physical addresses
  - Sixteen 64-bit integer registers
  - Sixteen 128-bit SSE/SSE2/SSE3/SSE4a registers
- **Family 16h Architecture**
  - Dual-core and quad-core options
  - Shared L2 cache architecture storage in addition to exclusive L1 cache
- **Cache Structures**
  - **32-Kbyte 8-Way Associative, Write-back ECC-Protected L1 Data Cache per Core**
    - Two 64-bit operations per cycle, 3-cycle latency
  - **32-Kbyte 2-Way Associative Parity-Protected L1 Instruction Cache per Core**
    - With advanced branch prediction
  - **2048[1] -Kbyte Maximum 16-Way Associative ECC-Protected L2 Cache Shared between Four Cores**

    [1] 2048 Kbytes of L2 cache are available on quad-core options, and 1024 Kbytes of L2 cache are available on dual-core options.
- **Floating-Point Unit**
  - Dedicated 128-bit floating-point unit (FPU)
- **Management and Virtualization Features**
  - AMD Virtualization™ technology
    - SVM pause count capability
    - SVM disable and lock
    - Rapid virtualization indexing (nested paging)
    - Improved world-switch speed

- **Power Management**
  - Multiple low-power states
  - AMD AllDay™ power technology
  - System Management Mode (SMM)
  - ACPI-compliant, including support for processor performance states (P-states)
  - Supports processor power states C0, C1, CC6, and PC6
  - Supports sleep states including S0, S3, S4, and S5
  - Supports adaptive S4
  - PCIe® power gating
  - PCIe speed power policy
- **Electrical Interfaces**
  - DDR3 SDRAM: Compliant with JEDEC DDR3 1.5V, DDR3L 1.35V, and DDR3U 1.25V SDRAM specifications
  - Refer to the *Electrical Data Sheet (EDS) for AMD Family 16h Models 00h-0Fh Processors*, order# 51492, for electrical details of AMD Family 16h (Models 00h-0Fh) processors.
- **Thermal Controls**
  - Sideband temperature control (SB-TSI)
  - Hardware thermal control (HTC)
  - Local hardware thermal control (LHTC)
  - DRAM thermal protection
  - Fan Control
- **PCIe® Technology**
  - PCIe Gen 1.0 and PCIe Gen 2.0 technology supported:
    - Four configurable x1 General Purpose Ports (GPP)
    - One configurable x4 GFX port[2]

    [2] GFX support is not available on Model 210J Processors
- **Integrated Memory Controller**
  - AMD Memory Controller PowerCap
  - Low-latency, high-bandwidth
  - DRAM Prefetcher:
    - Adaptive prefetching support
    - 32-entry DRAM prefetch table
    - Differentiation between core prefetch requests and core demand requests
  - FT3 package
    - 64-bit DDR3 SDRAM controller operating at frequencies up to 1600 MT/s (800 MHz)
    - DDR3 1.5V up to 1600 MT/s, DDR3L 1.35V up to 1600 MT/s, DDR3U 1.25V up to 1333 MT/s
    - Supports up to two dual-rank SODIMMs or unbuffered DIMMs
    - Supports DRAM down or single SODIMM plus DRAM down
    - Supports ECC

- **Integrated Controller Hub**
  - Supports
    - Universal Serial Bus (USB) versions 1.1, 2.0, and 3.0[3]
    - [3] USB 3.0 support is not available on Model 210J Processors
    - Serial ATA revision 2.0, 3.0 (up to 6 Gb/s)[4]
    - [4] SATA 3.0 support is not available on Model 210J Processors
    - Secure Digital (SD) 3.0:
      - SD/SDHC/SDXC support up to SDR104 transfer rate
      - 3.3V/1.8V signaling
    - System Management Bus (SMBus)
    - Low Pin Count (LPC) bus
    - High Definition (HD) audio
    - Serial IRQ
    - Serial Peripheral Interface (SPI)
    - Advanced Configuration and Power Interface (ACPI)
  - Functions
    - Real-Time Clock (RTC)
    - Programmable Interrupt Controller (PIC)
    - System Management Interrupt (SMI)
    - General-Purpose I/O (GPIO)
    - Power Management
    - Watchdog Timer (WDT)
    - Integrated Clock Generator
- **Available Packages**
  - Compliant with RoHS (EU Directive 2002/95/EC), with lead used only in small amounts in specifically exempted applications
  - FT3 package
    - Refer to the *AMD FT3 Functional Processor Data Sheet*, order# 51489, for functional and mechanical details of the FT3 package processor.
    - 769-ball, lidless micro BGA
    - Multi-pitch package with 0.65-mm minimum pitch
    - 24.5 mm x 24.5 mm
    - Organic C4 die attach

1.2 Graphics Features

This section lists the graphics features when the internal GPU is enabled.

- **Graphics**
  - Discrete-level graphics processor embedded alongside the x86 CPU complex
  - Dedicated graphics memory controller
  - Refer to *AMD Family 16h Models 00h-0Fh Processor Power and Thermal Data Sheet*, order# 51522, for graphics engine clock speeds
- **Power Management**
  - GPU power gating
  - UVD power gating
  - VCE power gating
  - GFX power gating
  - DCE power gating
  - SCLK, LCLK, DCLK and VCLK scaling
  - Graphics Memory Controller (GMC) power gating
  - AMD PowerPlay™ power management technology
  - Vari-Bright™ technology
  - Dynamic refresh rate
  - Frame Buffer Compression
  - Panel Self-Refresh
  - PowerTune
- **2D Acceleration Features**
  - Highly-optimized 128-bit engine, capable of processing multiple pixels per clock
  - Game acceleration including support for Microsoft® DirectDraw: Double Buffering, Virtual Sprites, Transparent Blit, and Masked Blit
  - Acceleration in 1/8/15/16/32-bpp modes:
    - Pseudocolor mode for 8 bpp
    - ARGB1555 and RGB565 modes for 16 bpp
    - ARGB8888 mode for 32 bpp
  - Support for GDI extensions:
    - In Windows® 7 and Windows 8: Alpha BLT, Transparent BLT, Color Fill BLT, and Stretch BLT
  - Hardware cursor (up to 128 pixels x 128 lines x 32 bpp), with alpha channel for direct support of Windows 7 and Windows 8 alpha cursor
- **3D Acceleration Features**
  - DirectX® 11.2 compliant, including full speed 32-bit floating point per component operations:
    - Shader Model 5 geometry and pixel support in a unified shader architecture
      - Graphics Core Next (GCN) architecture
      - Advanced shader instructions, including flexible flow control with CPU-level flexibility on branching
      - Read/Write caching system, replacing texture cache with a unified read-write two-level cache
      - Vertex, pixel, geometry, compute, domain, and hull shaders
      - 32-bit and 64-bit floating point processing per component
      - High performance dynamic branching and flow control
      - Shader instruction store, using an advanced caching system
      - Advanced shader design, with ultra-threading sequencer for high efficiency operations
      - Advanced, high performance branching support, including static and dynamic branching
      - High dynamic range rendering with floating point blending, texture filtering, and anti-aliasing support
      - 16-bit and 32-bit floating point components for high dynamic range computations
      - Full anti-aliasing on render surfaces up to and including 128-bit floating point formats
  - Support for OpenCL™ 1.2, DirectCompute 11 and Microsoft C++ AMP

- Support for OpenGL 4.1/4.1+
- Partially Resident Texture (PRT) support
- Anti-Aliasing Filtering:[5]
  - [5] Support for anti-aliasing filtering is dependent on application.
  - 2x/4x/8x MSAA (multi-sample anti-aliasing) modes are supported
  - Multi-sample algorithm with gamma correction, programmable sample patterns, and centroid sampling
  - Custom filter anti-aliasing with up to 12-samples per pixel
  - Adaptive anti-aliasing mode
  - Lossless color compression (up to 16:1)
- Anisotropic Filtering:[6]
  - [6] Support for anisotropic filtering is dependent on application.
  - Up to 128-tap texture filtering
  - Anisotropic biasing to allow trading quality for performance
  - Improved anisotropic filtering with unified non-power of two-tap distribution and higher precision filter computations
  - Advanced texture compression (3Dc+)
  - High quality 4:1 compression for normal maps and luminance maps
  - Angle-invariant algorithm for improved quality
  - Single-channel or two-channel data format
- 3D resources virtualized to a 40-bit addressing space, for support of large numbers of render targets and textures
- Support for up to 16k x 16k textures, including 128-bit/pixel textures
- Software-upgradeable, programmable arbitration logic maximizing memory efficiency
- Fully associative texture, color, and Z cache design
- Hierarchical Z and stencil buffers with early Z Test
- Lossless Z-buffer compression for both Z and stencil
- Fast Z-buffer clear
- Fast color-buffer clear
- Z cache optimized for real-time shadow rendering
- Z and color compression resources virtualized to a 32-bit addressing space, for simultaneous support of multiple render targets and textures

- **Motion Video Acceleration Features**
  - Supports DVD, Blu-ray, and SDTV/HDTV content playback with low CPU usage
  - Supports stereoscopic 3D Blu-ray
  - Video compression engine:
    - Dedicated hardware (VCE 2.0) assisted encoding of HD video streams to H.264 (main profile)
    - Support H.264 SVC temporal scalability
    - Real-time transcoding by encoding the output from UVD with reduction of CPU utilization and power consumption
  - Motion video decode acceleration technology:
    - Dedicated hardware (UVD) for H.264, MPEG4, VC-1, MVC, and MPEG2 decode:
      - H.264 implementation based on the ISO/IEC 14496-10 specification
      - MPEG[7] implementation based on the ISO/IEC 14496-2 specification
        - [7] Sprite, global motion compensation, and reversible variable length coding are not supported.
      - VC-1 implementation based on the SMPTE 421M specification
      - MPEG2 implementation based on the ISO 13818-2 specification
      - Multi View Coding (MVC) for Blu-ray 3D content
      - WMV-9 implementation
    - Real time high-definition and standard definition stream decode
    - Real time dual high-definition stream decode

- Microsoft DirectX video acceleration (DXVA) API (application programming interface) for Windows operating system

- **Motion Video Process Acceleration:**
  - Video scaling and YCrCb to RGB color space conversion for video playback and fully adjustable color controls
  - Motion adaptive and vector based de-interlacing filter eliminates video artifacts caused by displaying interlaced video on non-interlaced displays, and by analyzing image and using optimal de-interlacing functions on a per-pixel basis
  - HD HQV and SD HQV support: noise removal, detail enhancement, color enhancement, cadence detection, dynamic contrast, flesh tone correction, dynamic range, gamma, and advanced de-interlacing
  - Advanced up-conversion for SD to HD resolutions
- **Display Interfaces[8]**
  [8] Refer to Table 2 on page 12 for maximum resolution, color depth, and audio support per display interface.
  - Two independent display controllers[9] enabling dual displays in extended or clone modes
    [9] See the "Display Interface Design Guidelines" chapter in the *FT3 Processor Motherboard Design Guide*, order# 51387 for simultaneous display combinations and display restrictions.
  - HDCP[10] (High-bandwidth Digital Content Protection) supported on HDMI™ (High-Definition Multimedia Interface), DVI (Digital Visual Interface), Miracast, and DisplayPort
    [10] HDCP content protection support is available only to HDCP licensees and can be enabled only when connected to an HDCP-capable receiver.
  - DVI/HDMI Features[11]
    [11] Refer to Table 1 on page 11 for HDMI feature table.
    - Supports DVI or HDMI, using TMDS data encoding
    - Supports industry-standard CEA-861-D/E video modes including 480p, 720p, 1080i, and 1080p
    - Supports single-link DVI with resolutions of up to 1920 x 1200 @ 60 Hz, 24 bpp, RB
    - Maximum pixel clock rate of 162 MHz for single-link DVI, and 297 MHz for HDMI
    - HDMI modes up to 1920 x 1080 @ 60 Hz and Deep Color
    - Dolby® Digital, Dolby Digital Plus, DTS Digital, DTS-HD High Res, Dolby TrueHD and DTS-HD Master Audio
    - Supports stereoscopic 3D frame transport, and stereoscopic 3D gaming, Blu-ray 3D, and stereoscopic 3D video decoding via HDMI[12]
      [12] Support is available through software, in full-screen and windowed mode.
  - Integrated LVDS Interface
    - Integrated single-link 18-bit LVDS interface
    - 115 MHz pixel clock rate
    - FPDI-2 compliant
    - Programmable internal spread spectrum controller for the signals
  - Miracast Wireless Display Features
    - One wireless display low latency wireless display output at up to 1920 x 1080[13]
      [13] 1080 is available on selected models
      - Total display head limit remains two total with up to one being Miracast
    - Supports HDCP 2 protection for the wireless display output
    - Miracast compliant under Windows 8 when paired with specific Wi-Fi WLAN subsystems[14]
      [14] Contact your local AMD Embedded Sales Representative for a list of compatible Wi-Fi subsystems
  - DisplayPort Features
    - Supports all mandatory features of the VESA DisplayPort Standard, Version 1.2, plus the following optional features:
    - Supports DP++
    - Supports Panel Self Refresh (PSR)[15]

[15] Contact your local AMD Embedded Sales Representative for a list of qualified PSR panels

- DisplayPort audio
  - Linear PCM, Dolby Digital (AC-3), Dolby TrueHD, DTS, and DTS-HD Master Audio
  - LPCM at sample rates: 32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz, and 192 kHz, Bits per sample: 16, 20, and 24
  - Supports up to 8 channels
- Supports 4, 2, or 1-lane transmission
- Supports 5.4 Gbps, 2.7 Gbps, and 1.62 Gbps link bit rates
- Supports 1 Mbps Auxiliary Channel (AUX CH)
- Supports DisplayPort multi-streaming for up to two independent video and audio streams on one connector
- Maximum link bit rate of 5.4 Gbps
- Maximum resolution of 4096 x 2160 at 30 Hz and 24 bpp
- Supports Embedded DisplayPort (eDP) features as described in the VESA eDP Standard, Version 1.3
- Supports stereoscopic 3D frame transport, and stereoscopic 3D gaming, Blu-ray 3D, and stereoscopic 3D video decoding via eDP for 120-Hz sequential frame internal LCD panels

- VGA[16]/DAC Interface

[16] VGA is not available on Model 210J Processors

- Integrated triple DACs with built-in reference circuit
- RGB CRT output
- Maximum pixel frequency of 210 MHz
- Individual power-down feature for each of the three guns
- Fully compliant with electrical specification of VSIS v1r1
- Fully integrated with built-in bandgap reference circuitry
- Integrated monitor detection circuit

Table 1. HDMI™ Features

HDMI™ Feature	Compatibility
Link Capabilities	
Maximum Signal Bandwidth (MHz)	297
Maximum HDMI Data Bandwidth (Gbit/s)	8.91
Video Capabilities	
Maximum 2D Resolution[3]	1920 x 1080p at 60 Hz, 36 bpp[1] 1920 x 1200p at 60 Hz, 24 bpp 3840 x 2160 at 30 Hz, 24 bpp 4096 x 2160 @ 24 Hz, 24 bpp
RGB	Yes
YCbCr 4:4:4	Yes
YCbCr 4:2:2	Yes
HDMI™ 1.3 xvYCC	Yes
HDMI 1.3 Deep Color	Yes
Underscan	Yes
Maximum 4:4:4 Color Depth (bits per component)	12[2]
Maximum 4:2:2 Color Depth (bits per component)	12[2]
PCM (Pulse-Code Modulation) Audio Capabilities	
PCM Audio Rates Supported	192, 176.4, 96, 88.2, 48, 44.1, 32 KHz
PCM Audio Bits per Sample	24, 20, 16
PCM Audio Maximum Channels	8
PCM Audio Maximum Bandwidth (Rate × Bits × Channels)	36.864 Mbps
Compressed-Audio Capabilities	
Compressed-Audio Maximum Bandwidth	24.576 Mbps
Specific non-PCM Audio-Format Support	
IEC 61937 Compressed-Format support. For example, 5.1-channel Dolby® DTS and 5.1-channel AC-3.	Yes
Dolby-TrueHD Bitstream Capable	Yes
DTS-HD Master-Audio Bitstream Capable	Yes
DVD-A (DST) Support	No
SACD (DSD) Support	No
CEC (Consumer Electronic Control) Capabilities	
CEC	No
HDMI™ 3D Display Capabilities	
Packed Frame Stereo 3D Video Formats[3]	1080p at 60 Hz, 1080p at 30 Hz, 1080p at 24 Hz, 720p at 60 Hz, 720p at 50 Hz[4]

Notes:

1. 36-bpp mode uses 30 bpp of meaningfully derived data.
2. 12-bit mode uses 10 bits of meaningfully derived data.
3. Some models do not support the highest resolutions.
4. Stereo 3D refresh rates are specified per eye.

Table 2 shows the maximum resolution for each output configuration.

Table 2. Display Interface Support

Output Configuration	Maximum Resolution[3]	Bit Depth	Audio
eDP[1]	2560 x 1600 at 60 Hz	18, 24, 30 bpp	Not Supported
DisplayPort	4096 x 2160 at 30 Hz[4] 2560 x 1600 at 60 Hz	18, 24, 30 bpp	Supported[2]
Single-link DVI	1920 × 1200 at 60 Hz	24 bpp	Not Supported
Native HDMI™	4096 x 2160 at 24 Hz[4]	24 bpp	Supported
	3840 x 2160 at 30 Hz[4]	24 bpp	Supported
	1920 × 1080 at 60 Hz	24, 30, 36 bpp	Supported
	1920 × 1200 at 60 Hz	24 bpp	Supported
Single link LVDS (DP0 only)	1600 x 900 at 60 Hz	18 bpp	Not Supported
LVDS via eDP translator	1920 × 1200 at 60 Hz	18, 24 bpp	Not Supported
VGA	2048 x 1536 at 60 Hz	30 bpp	Not Supported

Notes:

1. Internal LCD panel.
2. Audio support is available for DisplayPort.
3. Some models do not support the highest resolutions.
4. Video playback is not guaranteed in this mode.